SECTION IV
AQUATIC ECOSYSTEM

MAPS REFERENCED

APPENDICES REFERENCED

SECTION IV
AQUATIC ECOSYSTEM

IV.1 WATER QUALITY

REFERENCE CONDITIONS

ANALYTIC QUESTION IV.1.1

What were the historic processes delivering sediment to streams?

Natural processes always have contributed sediment to stream channels. Major mechanisms include landslide processes like debris avalanches from drainage headwalls and shallow rapid debris torrents in steep gullies and canyons during high flow periods (Chatwin *et al.* 1994). These processes are coincident with large storm events. Lateral and vertical adjustments along larger streams channels, especially with flooding, are another important cause of sedimentation. Fires, though infrequent, lead to surface erosion and mass wasting for several subsequent winters.

Log drives early in the twentieth century scoured channels and delivered large quantities of sediment to the river (Wolniakowski 1990). F.A. Baker and H.S. Charlton began log drives from Brewster Valley above Dora (RM 18) in 1912. Log drives were common in Elk and Steel Creeks and the main stem of the East Fork for as many as twenty years. Drives in the watershed still were taking place as late as 1924 (Farnell 1979).

ANALYTIC QUESTION IV.1.2

Were historic stream water temperatures, particularly in the summer, lower than at present? What have been the factors of change?

Stream temperatures probably were cooler in the past (FEMAT 1993). Riparian zones contained contiguous conifer and hardwood cover which shaded streams. Agricultural clearing beginning in 1860s in Brewster Valley and splash damming removed riparian forests along the East Fork and low gradient stretches of tributary streams. Removal of shading vegetation directly contributed to solar exposure.

Historically, the abundance of large wood in stream channels modified stream gradients and provided more and larger pools. (see Section V.1). In the past, low-gradient, depositional stream types were narrower, deeper, and connected to a floodplain. Instream water received less solar heating, and may have exchanged with and replaced bank stored water in lowland alluvial reaches. This effect acted as a heat pump, removing heat from the stream in a down valley direction (Beschta 1996).

There were few stream diversions in the past, so more water stayed in the river during the summer. The additional water volume slowed temperature increases from direct solar heating.

The Fish and Wildlife Department sampled stream temperatures along the East Fork Coquille more than 30 years ago. A measurement of 67° F was recorded near RM 5.0 on July 16, 1969, and other measurements were as high as 74° F (Thompson *et al.* 1972). These temperatures exceed today's ODEQ Basin Standard of 64° F and may reflect 100 years of riparian forest manipulation (Beschta *et al.* 1987).

CURRENT CONDITIONS

ANALYTIC QUESTION IV.1.3

What is the current condition of stream channel types with respect to sediment transport and deposition processes?

The Rosgen Stream Channel Classification system (Rosgen 1996) is used to describe stream channel types. These types are defined above (see Section III.8). The analysis area contains Rosgen Aa+, A, B, C, and F stream channel types. An initial graphic representation is shown in Appendix A (Map A.11), in which the Rosgen categories are portrayed by slope class. Aa+ (very high gradient) channels have slopes of $10%, A (high gradient) channels have slopes between 4.1% and 9.9%, B (moderate gradient) channels have slopes between 1.5% and 4%, and C & F (low gradient) channels have slopes <1.5%.

<u>Very High Gradient Channels, Rosgen Aa+ Stream Types</u>
About 55% of all channel types in the analysis area are Aa+. The main processes affecting these channels are infrequent, shallow, rapid landsliding from steep headwalls and debris torrents. Sediment may accumulate in these channels as colluvium or dry ravel, but periodically is excavated by torrents. Aerial photo review indicates management activities have increased landslide frequency in all types of channels by 86.5% However, the channels are resilient, remaining essentially unchanged even though they are transportation routes for landslides and flows. In these channels the current condition is similar to the historic condition.

<u>High Gradient Channels, Rosgen A Stream Types</u>
About 30% of all channel types in the analysis area are A. Much of the original large woody debris has been removed from these channels in the past decades by salvaging or have been dislodged by debris torrents. Unnatural headcuts may have developed in type A streams with fine bed and bank materials (A4-A6) after past logging. This in-stream erosion source contributes to sedimentation.

Road crossings of A channels intercept wood and sediment where culverts are narrower than the stream width. Large wood that normally would be routed to C channels has been removed by road maintenance work. Many culverts are positioned flatter than the stream slope leading to substrate accumulation on the upstream side.

Moderate Gradient Channels, Rosgen B Stream Types

About 14% of all channels fit this type. The main processes at work in these channels include input of water, sediment, and LWD from upslope type A channels. Mechanisms include infrequent torrents, bank cutting, and channel entrenchment. Much LWD has been removed from this channel type, resulting in channel widening and downcutting or entrenchment. Sediment from streambanks or from upstream sources (A types) temporarily is stored behind obstructions or localized flats where natural stream grade controls are present. Where stream slope exceeds about 2%, fine and coarse sediments move downstream during frequent high flows. This stream type will not aggrade, even when sediment supply is high. Lack of LWD to trap gravels and create quality pools limits areas for fish spawning, rearing, and holding (FEMAT 1993).

Road crossings of B channels intercept wood and sediment where culverts are narrower than the stream width. Large wood that normally would be routed to C channels has been removed by road maintenance work. Many culverts are positioned flatter the stream slope leading to substrate accumulation on the upstream side.

Low Gradient Channels, Rosgen C and F Stream Types

About 3% of all channels fit these types. The processes affecting these channels are the input of water, wood and sediment from A and B stream types, and lateral and vertical adjustments through bankcutting and channel scouring.

In these stream types, LWD is floatable, and either is moved downstream during floods, or captured and lodged in simple arrangements behind boles of riparian trees, or anchored in jams. Notable jams include those on the West Fork Brummit Creek and near the mouth of Camas Creek. Large wood spanning the channel also can be buried and form a gradient step that accumulates sediment and gravels upstream. Large wood also slows bankcutting on the outside of bends. However, few large wood pieces or assemblages are present in these stream types (see Section V.1).

Much of the East Fork mainstem (excluding Brewster Gorge) now has F type entrenched channels. Historic splash dam releases and removal of large wood primarily are responsible for these deep streambeds and loss of floodplain connectivity (Wolniakowski 1990).

Low gradient C and F channels are depositional streams and have the highest risk for sediment accumulation. Aggradation by sediments reduces pool space, changes the size distribution of substrates toward the finer particles, and can cause channel widening. Increased widths and shallower depths raise stream temperatures, lowering habitat quality.

Substrate particle size measurements were taken in 13 drainages representative of low gradient C and F stream types during 1997. These were taken in riffles within the bankfull channel. Sand-sized and smaller particles made up between 6% and 29% of the total in each sample. West Fork Brummit Creek had the highest percentage of fine materials and Steel Creek the lowest (see Appendix G). Sediment may be interfering with some beneficial uses including fish and aquatic life in these low gradient streams.

ANALYTIC QUESTION IV.1.4

What are the current processes delivering sediment to tributary streams and where are the sediment source areas?

Processes which deliver sediment to tributary streams include debris avalanches and rapid, shallow, debris flows (see Section III.7). This delivery mechanism yields a high volume of sediment and debris, but occurs infrequently. Usually, soils already must be saturated and a rainfall event exceed four inches or more in a 24-hour period for significant initiation to occur.

Several areas throughout the watershed have rotated to a lower slope position in the recent geological past. These areas are a source of fine sediments that are easily placed into the stream network as a result of management activities. These land surfaces are unconsolidated and offer low resistance to the force of water. When these areas become saturated, they tend to gravitate to a lower position or into adjacent stream channels. This process causes a continual input of sediment into the stream, even when no management actions are taking place. The areas are identified as Quaternary Landslides on the Reconnaissance Geologic Map of the Dora and Sitkum Quadrangles, Coos County, OR. 1995, State of Oregon Dept. of Geology and Mineral Industries.

Other sediment source areas include: steep slopes and undisturbed vegetated headwalls on shallow to deep fine-textured soils above 1st and 2nd order channels (Appendix A - Map A.14 shows probable initiation of failure sites), old roads, and over-steepened landings. Substantial streambank sources of sediment also occur in some drainages, including: Yankee Run, Elk, Steel, and China Creeks.

Sediment sources due to forest management, especially forest roads, are well documented (Fredriksen 1970, Furniss *et al.* 1991, Meehan 1991, FEMAT 1993). Delivery of sediment to intermittent channels can occur after broadcast burning and lasts until the site revegetates, usually in one to two years. The resulting large amount of fine sediment may take several years to flush out.

The higher stream discharges occur several times a winter, and extreme events occur infrequently. These carry the majority of the sediment load. High flows occur less than 5% of the time, (see Figure III.6). Flooding can cause soil loss and delivery to streams, and extend the stream network to capture unconsolidated colluvium. Exceptionally heavy rainstorms (50 to 100-year events), like the November 18, 1996 storm, cause widespread landsliding directly into streams (Appendix A - Map A.14).

Turbidity is a measure of the cloudiness of water, which sometimes can be correlated with a suspended sediment load (Beschta 1980, Reiter and Beschta 1995). Source search sediment monitoring was done during the winter of 1995 - 96. Pre-storm and four storm period samples were taken and compared for 18 locations (Table IV.1). Results are shown in Figure IV.1. Prior to storms, turbidities were the lowest in Camas Creek (0.58 NTU) and highest in Yankee Run Creek (23 NTU). Storm monitoring indicated turbidity increases ranged from 1.9 to 75 times higher than the pre-storm levels (Knepper Creek, 10.4 and Steel Creek, 50-70 NTU respectively). Storm turbidities were highest in Yankee Run Creek (164 NTU), Elk Creek (70 NTU), Steel Creek (50-70 NTU) and moderately high in Dead Horse Creek, Camas Creek and China Creek, as well as several unnamed tributary streams.

No point-source for sediment delivery was identified in the lower 2.5 mi. of Steel Creek during source search monitoring conducted during the storm of 2/23/96. Rather, in-channel erosion appeared to be the contributing sediment source. Yankee Run Creek's high sediment loads also appear to be in-channel. No significant point-sources were found delivering sediment to the channel of Elk Creek, however, it's upper banks are composed of silty clay soils that are accessed during high flows.

Sediment Transfer Hazard Analysis is the potential of the stream to move sediment (Geier and Loggy 1995). This model incorporates both the transport efficiency of the streams and the bankfull runoff of the drainage. The bankfull flow is closely associated with a two-year flood event. Figure IV.2 compares the sediment transfer hazard among subwatersheds (Geier and Loggy 1995). Upper East Fork Coquille and Camas Creek subwatersheds have the highest risk, while Brummit and Elk Creek subwatersheds have a moderate risk. Brewster Canyon and Lower East Fork Coquille subwatersheds have low risks and principally are depositional streams.

Table IV.1
Turbidity Monitoring Station Locations

STA.	STREAM	LOCATION	STA.	STREAM	LOCATION
1	Knepper Creek	T28S R9W S12	10	Un-named Creek	T28S R10W S10
2	Un-named Creek	T28S R9W S14	11	China Creek	T28S R10W S5
3	Lost Creek	T28S R9W S9	12	Un-named Creek	T28S R11W S12
4	Un-named Creek	T28S R9W S8	13	Steel Creek	T28S R11W S12
5	Dead Horse Creek	T28S R9W S8	14	East Fork Coquille	T28S R11W S12
6	East Fork Coquille	T28S R9W S6	15	Un-named Creek	T28S R11W S10
7	Camas Creek	T28S R10W S12	16	Yankee Run Creek	T28S R11W S20
8	East Fork Coquille	T28S R10W S12	17	East Fork Coquille	T28S R11W S28
9	Brummit Creek	T28S R10W S10	18	Elk Creek	T28S R11W S33

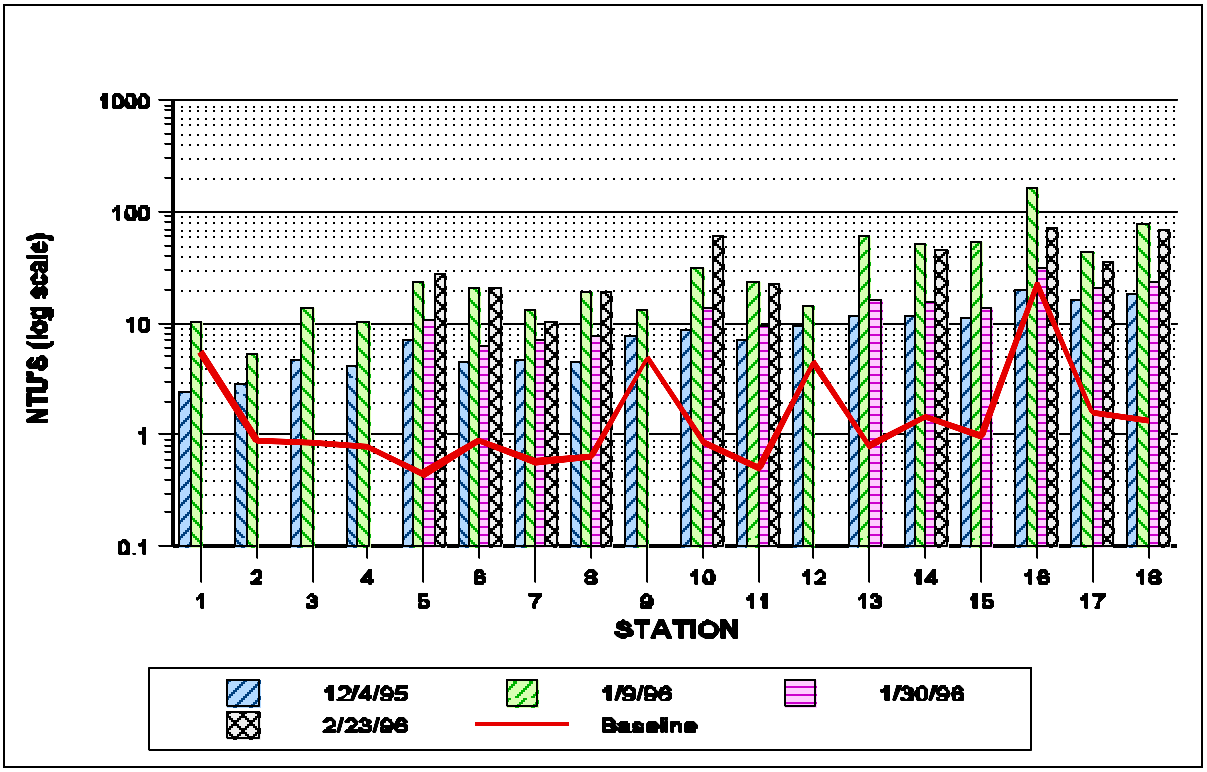

Figure IV.1. Turbidity monitoring results for Winter 1995-1996.

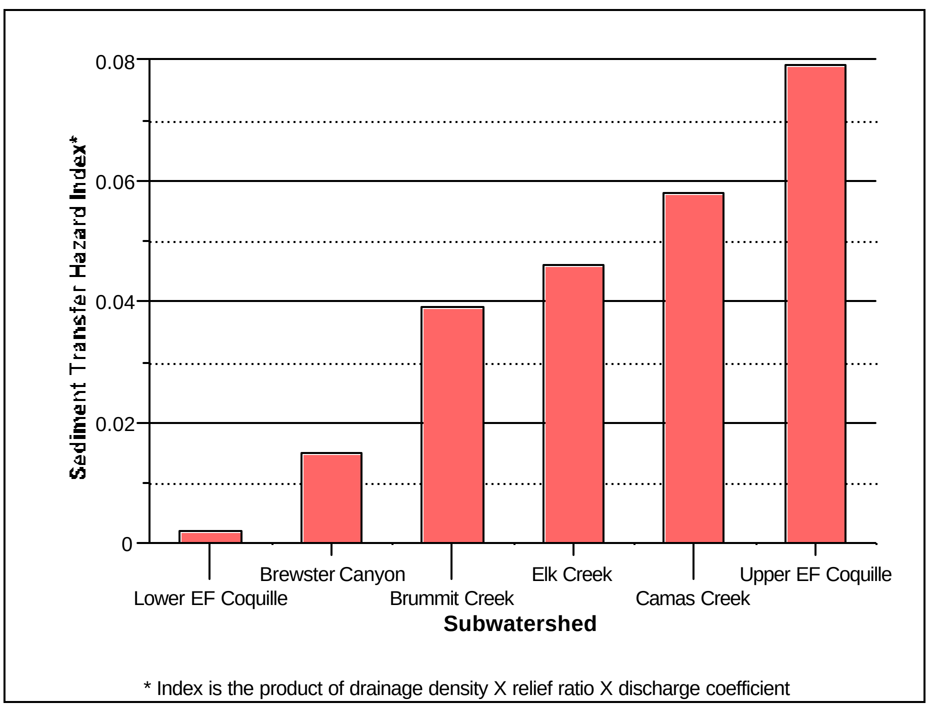

Figure IV.2. Index of sediment transport efficiency by subwatershed.

ANALYTIC QUESTION IV.1.5

Where are roads that contribute sediment to streams?

Due to the stable soils found throughout most of the area, few roads have had failures. Of the 12 ERFO road failure sites which occurred in the Myrtlewood Resource Area during the flooding of 1996, only three were located in the East Fork Coquille watershed (28-11-26.3 @ 26.5 junction, 27-11-12.0 above Brummit Creek, and 28-11-13.1). Also, roads adjacent to streams are asphalt or gravel surfaced, which significantly reduces sedimentation from surface runoff. Natural-surfaced (dirt) roads on BLM land do not appear to be major contributors to sedimentation, because twenty-five percent of the dirt roads are low-gradient roads through 30-50 year old timber. See Section VI.3 for more information on the transportation system.

Source areas for sediment delivery to stream channels are:

- un-maintained roads,
- natural surface roads,
- improper road drainage or road maintenance activities,
- road design,
- culverts that are either undersized or in poor condition, and
- runoff from landings and other compacted areas.

Except for mass-wasting and in-channel sources, dirt roads are probably the greatest source of fine sediments to streams during a typical rainy season (Furniss *et al.* 1991). The fines (silt and clay) move as suspended sediment. Sands and gravels (bedload) usually do not travel far in roadside ditches due to low water volumes and velocities. Excess fines from roads are a potential problem during, and immediately following, heavy rainstorms only if the sediment actually reaches a stream. If water from the road surface and ditch line filters through 30-50 ft. or more of vegetation before reaching a stream, most sediment will drop out. A stream-crossing culvert analysis was completed in 1997 on BLM-controlled roads using a basin characteristics flood frequency method. Culverts on 2nd order or larger streams were reviewed at 145 sites. A hydrologist noted culvert dimensions, condition, fill volume and diversion potential. Results indicate 17 (12%) need to be replaced immediately due to crushed or plugged inlets or pipes, 42 (29%) would pond water on the fill during a 100-year theoretical flood and should be scheduled for replacement according to risk, and 86 (59%) were in good condition.

A stream crossing location map was constructed by overlaying the streams and roads GIS themes (Appendix A - Map A.15). Stream crossings are shown with red dots, based on the intersection of roads with third order (and greater) streams. This stream size was used because third order (and greater) streams normally are sufficient to indicate a larger drainage area or perennial flow. All crossings are shown, regardless of type (culvert, bridge or none) or controlling organization (public or private). This map provides baseline information for evaluation of aquatic system barriers, which are a critical factor in restoration of fish runs.

ANALYTIC QUESTION IV.1.6

How quickly does water clarity recover after a storm event?

Watershed recovery after a major storm event is fair to good in terms of reduced sediment yield. Even the most turbid streams cleared up in 4 days from the major storm on 1/23/96 (USDI 1996a).

ANALYTIC QUESTION IV.1.7

What are the processes affecting dissolved oxygen levels and which stream segments are affected?

Low amounts of dissolved oxygen can affect water quality and aquatic habitat. The amount of dissolved oxygen in water is inversely proportional to temperature and directly proportional to atmospheric pressure. Except for low-flow periods, stream tumbling and aeration keep most tributaries at saturation for their given elevation and temperature. Microbial decomposition of organic matter (biochemical oxygen demand) may reduce dissolved oxygen levels. During late summer and fall dissolved oxygen may fall below saturation due to low flows, high water temperatures, and the addition and decomposition of leaf litter (Taylor and Adams 1986).

Ambient stream monitoring at RM 0.2 on the North Fork Coquille, nine miles downstream from the analysis area, shows dissolved oxygen exceeding criteria for 56% of samples taken (ODEQ 1994). No measurements have been recorded in the watershed. However, data in Powell (1997) and Tanner and Anderson (1996) suggests that dissolved oxygen in low-gradient reaches of the East Fork Coquille probably declines to low levels during late summer. Decomposing algae, exacerbated by warm water temperatures in these valley-bottom streams, is suspected of depressing oxygen levels. Beneficial uses, including aquatic life, are not fully supported during such declines.

ANALYTIC QUESTION IV.1.8

How much surface water is being withdrawn for out-of-stream uses, and where are the points of diversion (including domestic sources)? What effect does this have on summer flows?

Water is being applied to a variety of beneficial uses along the East Fork Coquille River below Camas Creek. They include: domestic use, irrigation, forest management and fire protection, stock watering, and a small sawmill. Irrigation water rights cover 1,350 irrigable acres. There is 51 ac./ft. of permitted reservoir water storage in the watershed. Figure IV.3 depicts the total duty of surface water consumptive use and a comparison with low summer flow (OWRD 1998).

Based on the available data, it appears that summer flows may be diminished by irrigation water use demand. These assumptions could be verified by summer flow data. If so, consumptive use may be lowering summer river levels and be one important element in explaining summer temperature increases along the East Fork Coquille. The local water master has observed in past years that the East Fork Coquille River goes below the certificated water right once out of every three years (Drolet 1998). If all permits were fully applied (they seldom are), adjudication by the WRD would become necessary as the consumptive demand would exceed the total available low flow.

The Oregon Dept. Of Fish and Wildlife (ODFW) has non-consumptive, in-stream flow, water rights for protection of fish and aquatic life. They are certificated at 20 cfs for the June-September period from the mouth of the East Fork to China Creek (RM 15.8). ODFW has two additional applications covering the East Fork from the mouth to Elk Creek (RM 3.8), and from China Creek to Brummit Creek (RM 20.7). There currently are no ODFW in-stream flow applications or non-consumptive water rights above Brummit Creek.

ANALYTIC QUESTION IV.1.9

What are the processes that increase summer stream water temperatures? Which stream segments frequently exceed the ODEQ water quality standards?

Streams in southwestern Oregon are known for their relatively high summertime temperatures. It is not clear whether this is related to latitudinal gradient, high solar radiation loads, low flows, or other related factors (Beschta *et al.* 1987). Stream temperature monitoring during the drought of 1992 did not show a strong correlation between maximum stream temperature and elevation (Oregon Forest Industries Council 1993). It is known that lack of shade and direct solar exposure during critical summer months is a principal factor in increased temperatures and water temperature increases in a downstream direction (Brown 1972, Beschta 1997). Appendix A - Map A.16 shows stream reaches that appear to lack adequate riparian canopy. The map displays many open areas, particularly on lower Camas and Brummit Creeks and the East Fork mainstem below Camas Creek. Direct solar heating is the greatest factor explaining temperature increases during summer months (Brown 1969).

BLM collected limited monitoring data during the summer of 1994, more extensive temperature data was gathered at nine sites in 1997. Other agency sources of temperature data include ODEQ with data collected at eight sites between 1994-1996. These temperature data are shown in Tables IV.2 and IV.3. Temperature information also has been collected by The Timber Company (formally Georgia Pacific) on their lands, but data is proprietary. Stream temperatures were assessed by placing small electronic data recorders in streams during the summer months. In most cases, periodic field temperature audits were done and other quality control/quality assurance procedures followed.

Temperatures in the East Fork Coquille strongly increase in a downstream direction. Summary data shows summer temperatures in the upper watershed above Camas Creek meet the South

Coast Basin Temperature standard of 64° F. Temperatures increase as the river gradient decreases and where the riparian vegetation has been removed for agricultural purposes. Loss of mixed hardwood and conifer riparian vegetation, extremely low flows, out of stream uses, and a wide shallow stream are all factors influencing summer heat load in the mainstem. Summer maximum temperatures increased at least 8.4° F over 23 mi. from Camas Creek to the mouth. A high temperature of 74.2° F was recorded by ODEQ at the mouth in 1996 and temperatures at this site exceeded the Basin standard for 80 days (Table IV.2). The day/night temperature differential (diurnal flux) is also the greatest in the lower river; having a seasonal difference of up to 14.7° F. These wide temperature swings indicate there is little riparian vegetation to buffer solar heat gain and radiation loss.

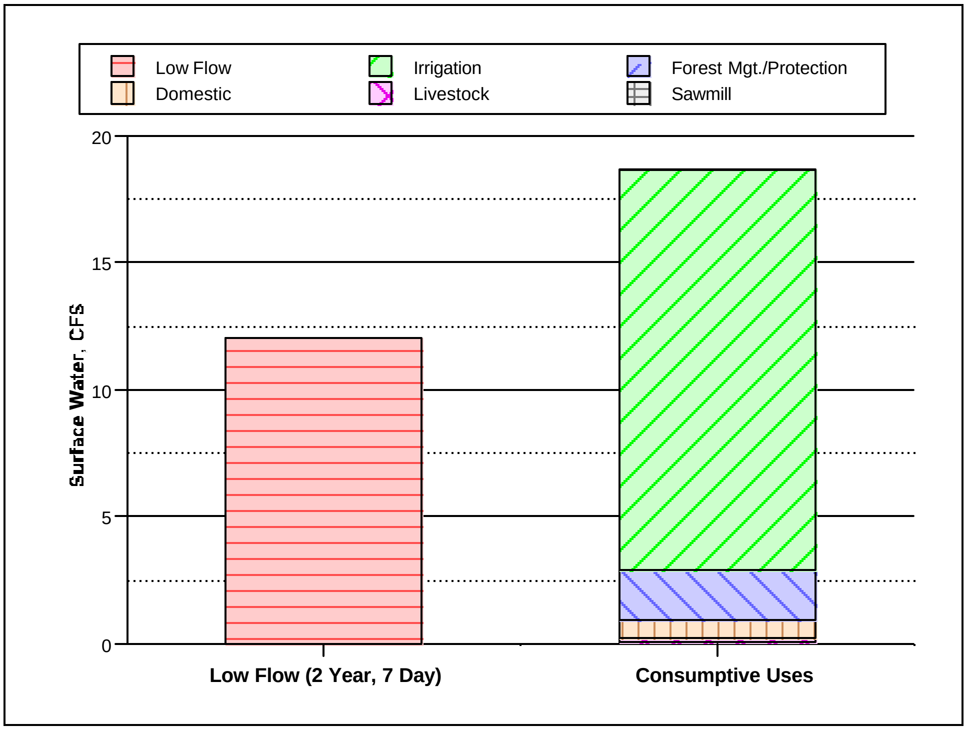

Figure IV.3. OWRD permitted Surface Water Rights and two-year seven-day low flow.

Several tributaries contribute heated water. Lower Elk Creek, a low-gradient stream running through agricultural lands, has summer periods exceeding standard. A high temperature of 67.3° F was recorded near the mouth of Elk Creek during 1997 (Table IV.3). Temperatures at this site exceeded the Basin standard for seven days. Seasonal diurnal flux ranged up to 13.6° F. Again, this wide temperature change indicates lack of stream-side vegetation. Weekly Creek also contributes high summer temperatures. A high temperature of 74.5° F was recorded by ODEQ in 1995, and temperatures at this site exceed the standard for 85 days. Seasonal diurnal flux ranged up to 14.2° F.

Flow contributions for each tributary would lead to better understand heat loading in the East Fork Coquille River. These data will be developed in the Water Quality Assessment portion of the 303(d) Water Quality Management Plan.

The East Fork Coquille from the mouth to the headwaters is on ODEQ's 1994/96 303(d) list of water quality limited streams. The seven-day, rolling-average, maximum temperature exceeded the basin criteria of 64° F. Based on BLM temperature monitoring in 1997, ODEQ is recommending de-listing the river from Lost Creek to the headwaters. Insufficient data was used on the 1994/96 list and cooler than expected waters were found high in the drainage after more intensive monitoring.

Fecal Coliform

ODEQ ambient stream monitoring at RM 0.2 on the North Fork Coquille (nine miles downstream from the analysis area), shows fecal coliform levels not exceeding basin criteria for all samples (ODEQ 1994). Beneficial uses, including water contact recreation, are fully supported.

SYNTHESIS AND INTERPRETATION

ANALYTIC QUESTION IV.1.10

What are the natural and human causes of change between historic and current hydrologic conditions?

Natural causes of change remain the same: landslides, debris flows, floods, and other extreme events. Approximately 3,000 years ago, there was a large landslide south of Brewster Gorge that caused two closed basins to form. One basin is approximately 120 ac. in size and contains 2.21 mi. of streams. The other is nearly twice the size at 290 ac. and has 3.72 mi. of streams. These streams that are disconnected from the East Fork Coquille stream network and do not directly contribute to surface flow.

Human causes of change include settlement and land clearing as well as log drives and flow diversions. Early splash dams and log drives in the lower East Fork Coquille and Elk and Steel Creek removed most of the large woody debris and probably was key in downcutting the channels (Wolniakowski 1990). The lowered channel base level has stranded former floodplains and is causing tributary streams to incise to the East Fork Coquille's level. Where entrenched streams have not widened enough for the frequent discharge to deposit sediment, (i.e. no floodplain is present) it will be carried downstream to the estuaries. These F channel types were converted from C types, and are not properly functioning.

Regeneration forestry and associated road building have increased the rate of landsliding, stream torrents and sediment delivery. See Section III.7.

Sediment was deposited in long term storage behind large woody debris in A and B type channels. Salvage logging of this material has routed sediments downstream.

Removal of riparian canopy shade has caused summer water temperatures to increase. Use of water for out-of-stream purposes may contribute to the temperature problem.

Table IV.2
ODEQ 1994-1997 Temperature Monitoring Summary

MONITORING SITES	MAX.	DATE	MIN.	DATE	DELTA T	7-DAY STATISTICS			DAYS >64E	SEA-SONAL MAX.> 64E
						7-DAY MAX.	7-DAY MIN.	7-DAY DELTA T		
EF Coquille @ Mouth	74.2	8/14/96	57.3	9/07/96	9.5	73.6	68.0	5.7	80	10.2
EF Coquille @ Mouth	74.1	8/04/95	60.1	8/20/95	8.2	73.0	66.6	6.4	80	10.1
EF Coquille @ RM 1.4	74.5	7/17/95	60.4	8/18/95	8.1	72.7	66.7	6.0	85	10.5
EF Coquille @ RM 2.5	73.8	7/17/95	55.9	6/22/95	7.4	72.0	66.8	5.2	94	9.8
EF Coquille @ RM 2.5	75.7	9/09/94	50.4	10/13/94	14.8	72.8	66.5	6.4	74	11.7
EF Coq. @ RM 16.2	67.1	7/19/94	48.6	7/07/94	5.8	66.5	61.5	5.0	46	3.1
EF Coq. @ RM 23.2	64.4	7/17/95	48.6	9/04/95	12.7	62.7	58.5	4.2	3	0.4
EF Coq. @ RM 23.2	65.8	7/21/94	45.5	10/17/94	6.3	64.4	59.8	4.6	5	1.8
Brummit Creek	67.0	8/04/95	53.9	8/18/95	7.2	65.8	59.5	6.4	17	3.0
Steel Creek	65.8	7/17/95	54.4	8/18/95	6.6	63.7	58.7	5.0	8	1.8
Weekly Creek @ Mouth	74.5	8/18/95	54.5	6/27/95	14.2	71.5	60.6	11.0	85	11.0

Definitions:
Delta T - Highest value of daily difference between max. and min. for the season
7 Day Max. - Average value of daily maximums for the highest seven consecutive 7 days
7 Day Min. - Average value of daily minimums for the same 7 days
7 Day Delta T - Average of the daily difference between max. and min. for the same 7 days
Seasonal Max. >64E- Number of degrees seasonal max. is above 64E F

Note:
Sampling period varies somewhat by station, but between 6/22-9/31

ANALYTIC QUESTION IV.1.11

How have the natural and human-caused changes in water quantity and timing of flows affected water quality?

Changes in channel morphology (F channel types) and lack of channel complexity have decreased summer flows, because these changes decrease water storage. Summer flows have also decreased due to out-of-stream uses (OWRD 1998). These factors contribute to high summer stream temperatures.

There is insufficient evidence to suggest that management activities have significantly changed normal or extreme flows or timing. Runoff during rain-on-snow events has been associated with mass-wasting of hillslopes, damage to riparian zones and downstream flooding. Studies indicate that runoff during rain-on-snow events is greater in open areas than in forests. In particular, areas where timber harvest and road building are extensive, peak flows may be exaggerated, producing increased channel scour and aggradation (Christner and Harr 1982).

Table IV.3
BLM 1997 Summer Temperature Monitoring Summary

STREAMS & SITE*	MAX.	DATE	MIN.	DATE	DELTA T	7-DAY STATISTICS			DAYS >64E	SEA-SONAL MAX.> 64E
						7-DAY MAX.	7-DAY MIN.	7-DAY DELTA T		
East Fork Coquille 1	66.4	7/15-17	53.1	6/6	13.3	65.7	64.3	1.5	14	2.4
East Fork Coquille 2	65.8	8/14	51.1	6/6	14.7	64.1	60.6	3.6	9	1.8
East Fork Coquille 3	63.2	6/24	48.3	6/24	14.9	59.7	57.1	2.6	0	0
China Creek	60.2	8/14,16	50.6	6/5	9.6	59.8	58.3	1.5	0	0
Dead Horse Creek	62.1	8/14	50.8	6/29	11.3	60.7	58.2	2.5	0	0
Elk Creek 1	67.3	7/5,7	54.7	6/27	12.6	66.1	58.3	7.9	7	3.3
Elk Creek 2	65.3	8/14	51.7	6/6	13.6	63.5	59.0	4.5	4	1.3
W. Fork Brummit Cr.	61.8	8/14	54.2	9/13	7.6	60.8	56.5	4.3	0	0
Yankee Run	62.1	7/15	51.7	6/6	10.4	61.4	58.9	2.4	0	0

Definitions:
Delta T - Highest value of daily difference between max. and min. for the season
7 Day Max. - Average value of daily maximums for the highest seven consecutive 7 days
7 Day Min. - Average value of daily minimums for the same 7 days
7 Day Delta T - Average of the daily difference between max. and min. for the same 7 days
Seasonal Max. >64E- Number of degrees seasonal max. is above 64E F
Note:
- Sampling period varies somewhat by station, but between 5/29-9/24

ANALYTIC QUESTION IV.1.12

How can future monitoring and management of the road system reduce sedimentation and other potential problems?

The BLM has completed a Transportation Management Objective (TMO) analysis for Federally-controlled roads in the watershed. Road type, condition, immediate and future needs, and the maintenance required to keep the road at the indicated level without resource damage are considered. Existing roads are maintained at various levels as defined in the Western Oregon Transportation Management Plan. Problem roads or road segments not needed for planned projects may be closed or decommissioned. Fully decommissioned roads have culverts removed, the drainage way reestablished, and the roadbed ripped and seeded with an erosion control/wildlife grass mix. New roads, road renovation, or improvements will meet Aquatic Conservation Strategy objectives and Best Management Practices listed in Appendix D of the District's Resource Management Plan. Roads will meet the National Marine Fisheries Service (NMFS) biological opinions and requirements for temporary, semi-permanent or permanent roads. These controls further reduce sediment delivery to stream channels.

ANALYTIC QUESTION IV.1.13

What is the trend in summer stream water temperature?

The trend of summertime temperatures is not known. The East Fork Coquille River currently is listed on ODEQ's 303(d) list for summer temperature. A Water Quality Management Plan (WQMP) and Total Maximum Daily Load (TMDL) assessment currently is being developed on Federal lands. ODEQ is coordinating the development of a watershed-wide WQMP / TMDL. This process undoubtably will include monitoring and checkpoints through time to determine improvement trends.

ANALYTIC QUESTION IV.1.14

Do the current sediment delivery processes interfere with beneficial uses?

The Non-Point Source Assessment (ODEQ 1988) states sediment for East Fork Coquille is a "moderate problem".

As management practices put more emphasis on prevention, sediment delivery is expected to trend toward natural rates on BLM lands (see Table III.8). A high percentage of streams on BLM-administered lands are steep, high energy streams (Rosgen A and B stream types) and do not retain sediment. A survey of depositional stream types (Rosgen type C and F) showed that on average, particles smaller than 2 mm. (sand size) in productive riffles were 16% of the total particle sizes recorded. This is less than other Coast Range streams, such as Big Creek in the Middle Fork Coquille. Although the average is fair, there are several streams where sedimentation is a problem for anadromous fish habitat. See Section IV.3 for more information on fisheries effects. Although fall and winter storms are able to flush sediments from most low gradient reaches, imbeddedness has not been evaluated. While interference with fish and aquatic life or other beneficial uses are not suspected to be a problem this has not been fully evaluated.

ANALYTIC QUESTION IV.1.15

What are the influences and relationships between water quality and other ecosystem processes in the watershed?

Relationship of Turbidity to Floods, Landsliding and Sediment Delivery Routing

Delivery of sediments and other materials from debris avalanches and rapid debris flows are the primary mechanisms for channel recruitment of sediment and high stream turbidities. Upper East Fork Coquille drainage has the highest sediment transfer hazard risk because of high drainage density, relief, and runoff (including rain-on-snow). Magnitude and probability of debris torrents depends on intensity and duration of rainfall. Such events usually have a return period of five years or greater.

Bank erosion is the second most important source of sediment and stream turbidity. Throughout the Roseburg and Lookingglass geologic formations, (Elk, Weekly, Yankee Run, and Steel Creeks) fine sediments are available in the streambanks. Although most streambeds are adequately armored, fine bank material can be accessed at annual high flows or greater, or where there is lateral migration of the channel, bank collapse, and bank undercutting.

Relationship of Water Temperature to Riparian Cover

Shade has been shown to be the most important factor decreasing the effect of thermal pollution by incoming solar radiation (Brown 1969).

The Aquatic Conservation Strategy (ACS) and pattern of Riparian Reserves on intermittent and perennial stream channels will provide thermal control by shading the streams, except in cases of natural disturbance. Stream temperatures in lower East Fork Coquille will continue to be elevated, unless streamside shade is restored. Water temperature from seeps and springs is dependant primarily on the underground soil temperature.

Relationship of Water Quality to Fire

Water quality generally decreases after a major fire (MacDonald *et al.* 1991). Depending on fire severity, there will be a flush of sediment from surface erosion and mass wasting processes. Also, there will be a loss of nutrients affecting stream chemistry. However, this effect is usually short-term (1-5 years) and fires in the region occur on an infrequent basis. See Appendix E.

ANALYTIC QUESTION IV.1.16

What effect have changes in riparian vegetation had on summer low stream flows?

Changes in channel morphology and riparian vegetation have affected low flows. Removal of forest vegetation has been shown to increase low flows by reducing evapotranspiration (Harr *et al.* 1979). However, because summer stream flows are very low in the East Fork Coquille, the additional water yield from harvested areas is small. Species conversion from conifer to hardwood (such as red alder) can decrease summer low flows from pre-harvest conditions, because this species transpires more water during the summer low flow period and acts as phreatophytic vegetation. The quantification of summer water loss in streams due to species conversion has not been thoroughly studied (Beschta 1996).

There are no studies quantifying the contribution of late summer flow from each tributary, or relating drainage area and riparian vegetation density and composition to flows.

ANALYTIC QUESTION IV.1.17

Is there adequate riparian canopy closure to maintain desirable stream temperatures for aquatic organisms?

With rare exceptions, surveyed portions of fish-bearing tributaries to the East Fork have adequate riparian canopy (Stream Habitat Inventory Data). However, the East Fork mainstem is [303d] listed as temperature-limited from its mouth upstream to the confluence with Lost Creek. This strongly suggests inadequate riparian canopy on the East Fork mainstem itself. “Higher than desired” stream temperatures may also be attributed to inadequate riparian canopy on un-surveyed tributaries, including non-fish-bearing streams (Bechta *et al.* 1987, Bisson *et al.* 1987).

A comprehensive review of 1997 aerial photography confirms that the East Fork mainstem has a high level of exposure to solar radiation from the mouth to just below the confluence of Lost Creek (Appendix A - Map A.16). Similar conditions appear on portions of 19 tributaries. Our definition of “High Exposure” stream segments are those where the water surface, stream channel, bars and banks are easily discernable from aerial photography. These stream segments have a sparse shade component and therefore receive direct solar radiation. Although this is a surrogate approach, it is useful for distinguishing areas where substantial stream heating may occur during periods of maximum solar exposure (July-August) and coincident low water flows. It is our interpretation that these stream reaches appear to lack adequate riparian canopy.

ANALYTIC QUESTION IV.1.18

What are the management objectives for water quality in the watershed?

The objectives are: water that fully supports beneficial uses and meets current water quality standards or amendments/criteria referred to in “Oregon's Criteria for Listing Waterbodies” (ODEQ 1996). This includes ensuring that actions meet Oregon's Antidegradation Policy. Soil and water conservation practices [Best Management Practices (BMP)] and project designs will be implemented to meet Oregon's water quality goals on Federal lands. The *Northwest Forest Plan FSEIS* (USDA and USDI 1994) and *Coos Bay District's Resource Management Plan Appendix D* (USDI 1995a) list many of the BMP's routinely used in management actions on Federal lands.

Sedimentation is the chief parameter of concern from BLM-administered lands, and has the highest probability of occurrence.

A TMDL/WQMP will be forthcoming that will discuss these issues and plan for fixes. The result will be improvement in fecal coliform and stream temperature conditions.

Due to the lack of LWD in most stream types, Riparian Reserve width's should be **$**100 ft. on each side of intermittent streams. Fish-bearing, perennial streams will have a 440-foot (two site-tree lengths) reserve on each side of the stream. This provides thermal protection during the summer and is wide enough to influence microclimates and likely retain cooler air temperatures.

ANALYTIC QUESTION IV.1.19

What are the management objectives for water quality in ODEQ [303d] listed streams?

The objective is to complete a WQMP on BLM lands. ODEQ will use this information in the development of a watershed-wide WQMP and a TMDL review to assign load allocations among landowners.

The Aquatic Conservation Strategy (ACS) suffices in most instances to protect the integrity and attributes of streams and channels. BLM roads or culverts causing sedimentation to streams will be corrected as indicated by TMO objectives and contingent on funding. Some roads will be fully decommissioned and the natural streams reestablished. See Section VI.3.

Stand prescriptions within Riparian Reserves include silvicultural activities for the attainment of ACS objectives. These will be planned and scheduled to prevent summer temperature increases above the Basin standard.

IV.2 AQUATIC HABITAT

REFERENCE CONDITIONS

ANALYTIC QUESTION IV.2.1

What was the historic condition and distribution of aquatic habitats, and how have human activities affected them?

There were no known quantitative surveys or measurements of aquatic habitat prior to 1949. By that time, impacts from human activities already were being manifest. However, the historic condition of aquatic habitats can be discerned in part from photographic evidence, anecdotal accounts (a.k.a. photographs & memories), and surveys of relatively undisturbed reference sites. These qualitative information sources include aerial photography (1939, 1943, and

1950), and reports from Wolniakowski (1990) and Farnell (1979). These resources indicate the following:

- Large wood was very abundant in streams (both in aggregations and as single pieces), originating from stream-adjacent windthrow, channel migration, landslides, and debris torrents.
- Beaver were abundant at the turn of the century. Habitat conditions associated with beaver (large complex pools, channel complexity, alcoves, certain riparian vegetation) probably were common (USDI 1997a).

Extrapolation based on aquatic inventory information suggest the following are the primary effects of human activities on the aquatic and riparian systems:

- Extensive harvest of riparian vegetation reduced inputs of large wood and levels of shading. This resulted in the loss of instream complexity, downcutting of stream channels, and high water temperatures.
- Splash dams and logs drives scoured riparian vegetation and, in combination with stream-cleaning, reduced large roughness elements (boulders, logs, beaver dams). This resulted in habitat simplification, channel down-cutting, sedimentation, etc.
- Extensive riparian road networks encroached on streams, generating and routing sediment into streams, increasing downcutting, and disconnecting streams from floodplains. Construction of roads and installation of culverts severed connections between larger streams and tributaries, blocking passage for many organisms as well as blocking inputs of wood and boulders from debris torrents and landslides.

CURRENT CONDITIONS

ANALYTIC QUESTION IV.2.2

What is the current abundance, distribution and condition of spawning and rearing habitat for anadromous and resident fish?

The watershed contains approximately 44 mi. of anadromous and resident fish-bearing streams, and an additional 105 mi. of resident-only fish only use (Appendix A - Map A.17). Anadromous spawning habitat is widely distributed in the west half of the watershed, along lower-gradient 3rd to 5th order stream reaches. Stream habitat inventory data is summarized in Appendix H.

Spawning & Incubation Habitat

There are no basin-wide assessments of available spawning habitat. Furthermore, the amount and quality of available spawning habitat varies annually according to flow conditions (depth and velocity). Spawning surveys have been conducted on a limited number of streams by theBLM and ODFW, (reports on file in the BLM, ODFW offices). These surveys document the existence and use of anadromous spawning habitat (see Appendix H).

The 1992-97 inventories indicate that most riffles (assumed to be spawning habitat) contained a moderate amount of sand, silt and organic matter (see Appendix H). However, the amount and condition of gravel in riffles in late summer (when inventories were conducted) may not represent spawning conditions during the fall and winter, when higher flows clean fines from riffles and redistribute gravel beds. Furthermore, floods during November 18-19, 1996 contributed and redistributed a large amount of sediment. Cursory examination and anecdotal evidence following the flood suggests new gravel beds were created.

Rearing Habitat

Structurally complex habitats important for salmonid rearing are few and far between. For stream reaches surveyed, LWD was in very low abundance. The present LWD loading contributes only nominally to habitat complexity and provides minimal cover at moderate to high discharge. In general, pool habitat is fairly common throughout the watershed. However, complex pools (small to large LWD accumulations that provide cover for fish through most stream discharge levels) are rare.

ANALYTIC QUESTION IV.2.3

What is the current abundance, distribution and condition of aquatic habitats for other aquatic and riparian associated species, and how are they maintained?

No recent aquatic habitat inventory data is available for the East Fork Coquille River, East Fork Brummit Creek, or Lausch Creek. However, the most recent aquatic habitat inventory data (1992-1997) for the majority of the East Fork is summarized in Appendix H. The stream reaches referenced in these tables are depicted in Appendix A - Map A.18. These data [BLM and ODFW] indicate the following habitat component conditions:

Generally, there are adequate numbers of pools well distributed throughout the surveyed portions of East Fork Coquille tributaries. Most reaches which rated poor with respect to the pool area and/or pool frequency benchmarks are Rosgen type A or Aa+ channels, where pools typically are not well represented due to the steep gradients. However, it should be noted that most pools in surveyed reaches rated fair to poor with respect to residual pool depth and pool complexity.

With the exception of Steel Creek and Camas Creek, the surveyed tributaries in the East Fork Coquille Watershed are in good condition with regard to width-to-depth ratio. This probably is attributable to the fact that most surveyed reaches are Rosgen A or B type channels, which are fairly resilient with respect to width-to-depth ratio. However, Steel Creek and Camas Creek have incised to bedrock and subsequently widened through bank erosion. The high width-to-depth ratios result from low summer flows over bedrock substrates. This condition also is typical of unconstrained reaches of the East Fork Coquille River. A high width-to-depth ratio is problematic, because the increase in surface area renders the stream more susceptible to warming (Brown 1972, Beschta 1997).

There is an overabundance of fine sediments (silt, sand, and organic material) in riffles of Weekly, Yankee Run, Dead Horse, and Knepper Creeks. This problem is the result of excessive fine-sediment delivery and/or a stream's inability to adequately sort, store, and transport fine sediments. The sorting and storage of fine sediments is a function of LWD loading in Rosgen type A and B channels; LWD generally enhances in-channel storage capacity and creates scour elements such that riffle habitats are not inundated by fine sediments. Excessive fine sediments can result in poor egg-to-fry survival of salmonids, because fine sediments restrict the flow of water through the interstitial spaces in spawning gravel, thereby suffocating eggs. These interstitial spaces also are primary habitat areas for larval amphibians, lamprey ammocoetes, and aquatic macroinvertebrates.

Weekly, Elk, Yankee Run, Hantz and lower Steel Creeks are deficient in the quantity and quality of LWD present. Large conifers (>20" DBH) generally are scarce in the associated riparian areas, and there is little current recruitment of large wood to streams in these drainages, primarily due to the history of fire and logging, and the resultant young and maturing stands (see discussion on LWD recruitment potential).

ANALYTIC QUESTION IV.2.4

Where are the highly productive habitats ("hot spots") for salmonids?

Despite the general absence of structurally complex areas, several discrete areas exist which currently provide or have the potential to provide high-quality rearing habitat. These "hot spots" include:

- **S. Fork Elk Creek**: The upper reach meanders through a beaver complex in a narrow floodplain at the upper extent of anadromous fish use. This adjacent riparian area is free of roads, moderately-to-well shaded, and no culverts are present.
- **Yankee Run Creek (left fork)**: Low gradient, lateral pools and undercut banks common.
- **Weekly Creek**: Low-gradient reach below the first falls, meanders through a narrow floodplain. A BLM restoration project enhanced the LWD loading in this reach. The stream is very well shaded.

ANALYTIC QUESTION IV.2.5

Where are the natural and human-caused obstructions to the movement and dispersal of fish or other aquatic species?

Miles of anadromous fish distribution vary yearly, based on escapement, habitat and flow conditions. For anadromous fish, access to spawning and rearing habitat in the watershed is limited by the following natural barriers or habitat conditions:

- **Mainstem East Fork Coquille**: Brewster Gorge (T28S, R10W, Section 9)
- **China Creek**: left fork - 7'-high falls 500' upstream; right fork - high gradient and poor habitat 500' upstream
- **Steel Creek**: high gradient cascade (T28S, R11W, Section 1 - NE¼)
- **Elk Creek**: S. Fork - high gradient approximately 1500' above forks in T28S, R10W, Section 19 - SW¼ SE¼¼.
- **Weekly Creek**: 9 ft.-high fall in T29S, R11W, Section 5 - NE¼

The movement and dispersal of fish or other aquatic species is also limited by numerous man-made barriers. Road densities are moderate to high (up to 5.45 road mi/mi^2). Many perennial streams throughout the watershed are crossed multiple times by roads. Roads and stream-crossing structures have been shown to function as barriers to the movement and dispersal of many fish and riparian wildlife species (Furniss *et al.* 1991). Road crossings can inhibit fish passage due to blockage, deterioration, or poor design (outfall barriers, excessive water velocities, disorienting turbulence, flow patterns, etc.). Culverts placed above the water level may only permit entry for larger fish with substantial jumping ability; entry by organisms with limited or nonexistent jumping abilities (i.e., juvenile salmonids, sculpin, herptiles, crustaceans, molluscs) is nearly impossible. Furthermore, lack of natural substrate in culvert bottoms may prohibit passage by organisms which require roughness, cover, and a precise microclimate. Currently, five culverts in the watershed are probable barriers to anadromous fish. Nearly every stream-crossing culvert in the watershed is a barrier to upstream migration of other stream organisms due to disconnection of culvert outlet from the natural stream bottom and/or lack of natural substrate in the culvert-bottoms. Notable exceptions are located on Yankee Run Creek and at Weekly Creek, where culverts have accumulated a substantial amount of gravel. South Fork Camas Cr. contains a 24 ft. high manmade barrier at the 28-9-32.1 road crossing.

SYNTHESIS AND INTERPRETATION

ANALYTIC QUESTION IV.2.6

What are the influences and relationships of aquatic habitats with other ecosystem processes?

The harvest in riparian areas has subjected streams to diminished long-term large wood input throughout the analysis area, and temperature increases on the mainstem East Fork Coquille River (Swanson *et al.* 1976, Swanson and Lienkaemper 1978, Grette 1985, Beschta 1997). Roads constructed directly adjacent to streams have compounded the problem by converting riparian areas to younger seral or disturbance habitats, and increasing sediment delivery to streams. Roads also have confined streams to narrower channels, thereby increasing velocities and simplifying the hydrological characteristics within the channels (China Creek for example). Both natural and human-related fires and landslides have also modified riparian and stream channel characteristics dramatically.

Aquatic and riparian habitat in the lower 12 mi. of the East Fork Coquille River has been greatly modified by the clearing of the floodplain for agricultural/pasture land and log transport practices. A detailed study of the effects of splash damming on stream channels is given in Wolniakowski (1990). In summary, overhanging bank vegetation was cut and boulders and large woody debris were removed to facilitate log transport. The result of this was a loss of habitat complexity, destabilization of banks, channel incisement and accelerated sediment transport.

Stream channels were vastly more complex in their historic condition than at present, owing to the structure provided by boulders and abundant large wood. This structural complexity functioned as a filtering mechanism. Thus, a large percentage of the annual nutrient and organic carbon inputs were in the form of leaf/needle litter, fine woody material, and carcasses from anadromous fish. These were retained within system to be released over time by bacteria, fungi, and detritivors. This supply of nutrients and energy in turn fueled primary and secondary production, which contributed to a healthy and vigorous fish and wildlife community. This process has been altered directly and indirectly by simplification of the stream channels throughout most of the watershed. With reduced channel complexity, the filtering mechanism is impaired, such that nutrients and organic carbon inputs are exported from the system more rapidly. This leads to reduced productivity in the system. Furthermore, the reduction in channel complexity translates into diminished habitat, which has impaired the system's capacity to successfully rear juvenile anadromous salmonids, and in turn has reduced the number of returning adults with their concomitant nutrient and organic carbon inputs (Bilby *et al.* 1996 and Gresh *et al.* 2000). Finally, changes in the riparian plant community have altered the quality and quantity of organic inputs from litter. Such a change undoubtedly has altered the watershed's microbial and invertebrate fauna, and thus affected both the mechanisms and rates of nutrient and organic carbon cycling in the watershed.

A second process that has been altered as a result of channel simplification is the flow of sediments. As with nutrients and reduced carbon, a structurally complex stream channel impedes the export of sediment by trapping it, dissipating stream energy, and creating depositional areas. While the net flow of sediments is necessarily downstream, the rate and periodicity of transport are variable, and are moderated by channel structural complexity. In a structurally complex channel, small quantities of sediment move relatively slowly downstream in most years, and this process is punctuated by infrequent, high-runoff events that rework the channel by moving large amounts of sediment and debris. While dynamic, sediment export is roughly comparable to sediment delivery over time, such that this system strikes a balance in which substrate composition is maintained throughout the system. However, in a simplified channel, displacement of significant quantities of sediment may occur very frequently, and the balance is lost. As a result of channel simplification from splash damming, road construction, and removal of woody debris, lower Steel Creek, lower Elk Creek, and the lower 12 mi. of the East Fork Coquille River are incised, dissociated from their floodplains, and dominated by bedrock substrates. Simplified bedrock channels that lack the potential for recruitment of large wood cannot trap sediments or other structures necessary for deposition of gravels and creation of spawning and rearing habitats.

Log jams are important contributors to the biologic and hydrologic process of streams and rivers. They are especially important in maintaining water tables for low flow releases, and for causing interactions of the stream or river with the floodplain.

ANALYTIC QUESTION IV.2.7

What are the trends in aquatic habitat condition?

It is difficult to compare data from the 1973 and 1994 surveys because they were collected using different methods and for different objectives. However, two general comparisons of habitat conditions between the two decades can be made. First, in 1973, streams throughout the analysis area were dominated by large wood, both in aggregations and single pieces. In contrast, two decades later, wood is practically non-existent, either as single pieces or in aggregations. Second, beaver dams were abundant in surveyed streams in 1973 while in 1994, beaver dams still were present but less frequent.

Left alone, natural processes such as succession in the riparian community, gradually will improve the quality of aquatic and riparian habitat, restore other processes, such as nutrient and sediment flows, and facilitate the recovery of indigenous fish populations and other sensitive aquatic organisms in the watershed. However, this natural recovery process is threatened because critical components are missing (i.e., potential for recruitment of large wood, accelerated sediment delivery, floodplain connectivity, thermal refugia, winter refugia), and impacts within and outside the watershed continue. Furthermore, in its present condition, the majority of the analysis area is ill-equipped to handle unpredictable events, such as flooding or wildfire.

Aquatic habitat enhancement projects (such as the LWD structures on Weekly Creek and the boulder weirs on Elk Creek) have resulted in appreciable increases in pool habitat quality as indicated by the survey data.

The rating of most pools as poor or fair is of special concern in tributaries downstream of Brewster Gorge, because shallow pools with little or no cover are inadequate for over-winter rearing of coho salmon. This shortcoming is largely due to the scarcity of large woody debris, which facilitates scour. Taken together, this data indicates that the streams in the analysis area have impaired rearing potential.

ANALYTIC QUESTION IV.2.8

What are the management objectives for aquatic habitats on Federal lands?

Stream Channel

The management objective for stream channels is to meet or exceed the ODFW (1997) criteria for "good" habitat with respect to all parameters in all fish-bearing reaches, as verified by aquatic habitat surveys. Such conditions are required throughout the watershed to sustain the varied life histories of sensitive fish and wildlife species, to provide substrates for primary and secondary production, and to benefit water quality through numerous physical and biological processes.

Connectivity

A management objective is to maintain and restore connectivity between and within streams for all aquatic species. Human-caused barriers and impediments to movement and dispersal, such as deteriorated or poorly designed culverts, should be removed or modified to allow all species access to historic habitat. Specifically, culverts should be placed in contact with the stream bed and designed to replicate natural stream bottoms (i.e., to collect gravel throughout).

Emphasis on Processes

A management objective is to restore the processes which create and maintain habitat for aquatic organisms. The input of large wood and boulders onto floodplains and into stream channels via landslides and debris torrents is an integral part of creating and maintaining habitat for riparian and aquatic organisms. At present, the input of these materials via landslides and debris torrents is frequently blocked by riparian roads and culverts. The removal (when possible) of riparian roads and/or avoidance of road construction in riparian zones helps restore or maintain inputs of large material.

Protect Refugia

Portions of the watershed currently providing good-quality habitat for fishes, invertebrates, amphibians, and other aquatic species should receive priority in protection and restoration. In drainages such as Middle Fork Brummit Creek, where habitat is generally good, or where culverts are few or absent (such as Bills Creek) and stream ecosystem connectivity is relatively intact, management activities on Federal lands should avoid installation of structures such as roads and culverts which may restrict access of species to habitat.

Habitat Quality

“Any species-specific strategy aimed at defining explicit standards for habitat elements would be insufficient for protecting even the target species” (USDA and USDI 1994:B-9). Projects to restore or improve habitat quality should focus on restoring conditions appropriate for all aquatic organisms. A specific management objective for habitat quality is twofold:

(1) meet or exceed ODFW criteria for “good” fish habitat, and
(2) conduct habitat improvement projects that create and maintain a diverse array of flow conditions and substrates to support diverse invertebrate and amphibian communities.

Cooperation

Opportunities exist throughout the watershed for joint habitat-restoration projects with willing private landowners and the Coquille Watershed Association. Management should focus on establishing joint project-goals and sharing implementation and monitoring of subsequent projects.

Emphasis on Aquatic-Riparian Linkages

Riparian zones, floodplains, and streams depend on each other to function properly. Management activities should focus on creating and maintaining hydrologic and physical links between the two riparian and aquatic systems, including: placement of instream-structures which aggrade stream channels and route water onto floodplains, placement of large wood to link stream channels to floodplains, enhance in-channel sediment storage, and provide habitat for riparian and aquatic organisms.

IV.3 AQUATIC SPECIES

REFERENCE CONDITIONS

ANALYTIC QUESTION IV.3.1

What fish species historically occupied the drainages?

No information on species occupancy in the East Fork Coquille watershed is known prior to 1949. Formal aquatic and riparian habitat surveys are summarized in Appendix H. These early efforts primarily were intended to locate potential passage barriers for anadromous fish. Species other than anadromous fish and beaver (i.e., amphibians, invertebrates) were not evaluated.

CURRENT CONDITIONS

ANALYTIC QUESTION IV.3.2

What fish species currently are present, and how are they distributed?

The current fish distribution map has been presented above (see Appendix A - Map A.17). Table IV.4 contains the species and species functional groups or guilds found in the analysis area. Specific information about each species or group with special management status follows the table. Although there have been no known recent extinctions, populations size and distribution have changed.

Table IV.4
Aquatic and Riparian Species of Ecological Concern

Species Group/Guild	Common Name	Scientific Name	Habitat Association	Population Trend	Status
herbivorous	Beaver	*Castor canadensis*	Loti, lentic, riparian	unknown	ecological concern[1]
insectivorous	Chinook salmon (fall)	*Oncorhynchus tshawytscha*	Lotic	stable	ecological concern[1]
insectivorous	Coho salmon	*O. kisutch*	Lotic, lentic	decreasing	Candidate T&E At risk of extinction[2]
insectivorous/piscivorous	Coastal cutthroat trout	*O. clarki*	Lotic, lentic	decreasing	Candidate T&E At risk of extinction[2]
insectivorous	Winter steelhead	*O. mykiss*	Lotic	decreasing	Candidate T&E At risk of extinction[2]
omnivore	Pacific Lamprey	*L. tridentata*	Lotic (channel margins)	decreasing	State Sensitive-Vulnerable
insectivorous/piscivorous	Pacific Giant Salamander	*Dicamptodon tenebrosus*	Lotic, lentic, riparian, springs/seeps	unknown	ecological concern[1]
insectivorous	Southern Torrent Salamander	*Rhyacotriton variegatus*	Lotic (channel margins), springs/seeps	unknown	State Special Status-Critical
insectivorous	Dunn's Salamander	*Plethodun dunni*	Riparian, springs/seeps	unknown	ecological concern[1]
scraper/herbivore (tadpole) insectivorous (adult)	Tailed Frog	*Ascaphus truei*	Tadpole: Lotic Adult: Lotic, riparian	unknown	Bureau Tracking State Sensitive-Vulnerable

Species Group/Guild	Common Name	Scientific Name	Habitat Association	Population Trend	Status
collector-gatherer/omnivore (tadpole)	Red-legged Frog	*Rana aurora*	Tadpole: Lotic (channel margins), lentic, springs/seeps Adult: Lotic, lentic, springs/seeps, riparian	unknown	Bureau Tracking State Sensitive-Vulnerable
scraper-herbivore	Beers's false water penny beetle	*Acneus beeri*	Larvae: Lotic (cobble, rubble) Adult: unknown	unknown	Former Federal Candidate 2 Bureau Tracking
scraper-herbivore	Burnelli's false water penny beetle	*Acneus burnelli*	Larvae: Lotic (cobble, rubble) Adult: unknown	unknown	Former Federal Candidate 2 Bureau Tracking
insectivorous	Montane bog dragonfly	*Tanypteryx hageni*	Larvae: Lentic, springs,/seeps Adult: riparian	unknown	Bureau Tracking
scraper-herbivore	Denning's Agapaetus caddisfly	*Agapaetus denningi*	Larvae: small springs Adult: riparian	unknown	Bureau Tracking

[1] Species without specific legal or management status but are of concern due to role in ecosystem function.
[2] At risk of extinction according to Nehlson *et al.* (1991).

Note:
Species listed have been found in the watershed or incorporate the watershed in their home range.

Table IV.4 lists species that are obligate users of streams or riparian areas during their life cycle that are found or are likely found within the watershed. Species are grouped by guild to emphasize functional relationships.

Fall Chinook Salmon

The biology and life-history of chinook salmon have been summarized elsewhere (see Groot and Margolis 1995). The fall chinook salmon of the East Fork Coquille Watershed and the Coquille River basin are "ocean-type" and are part of a gene conservation group extending from Coos Bay to Elk River. Among the fall chinook populations in this group, the Coquille (and Coos) populations tend to be relatively small-bodied, with an age at maturity that is intermediate compared to other coastal populations (Nicholas and Hankin 1989, cited in ODFW 1995a).

Adult chinook return to the East Fork Coquille River and its tributaries from the ocean in the late October and spawning occurs until mid-December. Chinook primarily use lower Elk Creek, Steel Creek, lower Yankee Run Creek, and the mainstem river downstream of Brewster Gorge. Chinook salmon were also observed in China Creek in the past. Peak spawning usually occurs from the second week of November through the first week in December. After emergence, chinook juveniles rear in the analysis area from three to six months before migrating to the estuary or ocean.

Insufficient data exists to accurately estimate the historic or current chinook population levels in the analysis area. However, for management purposes, it is assumed that population levels and trends in the East Fork Coquille Watershed have mimicked those of the entire Coquille basin (for which there is rough population data). According to cannery records, the Coquille commercial catch ranged from 1,000-19,000 fish annually from the 1890s to 1924 and then declined until the fishery was closed in 1957 (ODFW 1995a). ODFW fall spawning ground counts in the Coquille basin indicate that fall chinook rebounded steadily in abundance during the 1960s, then remained relatively stable through the 1990s. ODFW peak count data from the analysis area (Figure IV.4) shows essentially the same pattern as the larger basin. While the available data suggests a fairly stable fall chinook salmon population, it should be noted that major impacts to the population probably occurred before spawning survey data was collected. Current population sizes in the Coquille River basin cannot be accurately measured, but are estimated to range from 1,800-7,500 adults (ODFW 1995a). The relative contribution of the East Fork Coquille Watershed to the population has not been estimated.

Coho Salmon

The coho salmon of the East Fork Coquille Watershed belong to a gene conservation group ranging from the coastal lake region between the Siuslaw River and Coos Bay to Cape Blanco (ODFW 1995a). Adult coho return to the East Fork Coquille River and its tributaries in early November and spawn until mid-January. Peak spawning activity occurs from early to late December, dependant upon tributary and rainfall. Juvenile coho spend one summer and one winter in their natal streams before migrating to the ocean.

Insufficient data exists to accurately estimate historic coho population. Steel Creek is the only ODFW index reach for coho in the analysis area, hence the only relevant long-term data set.

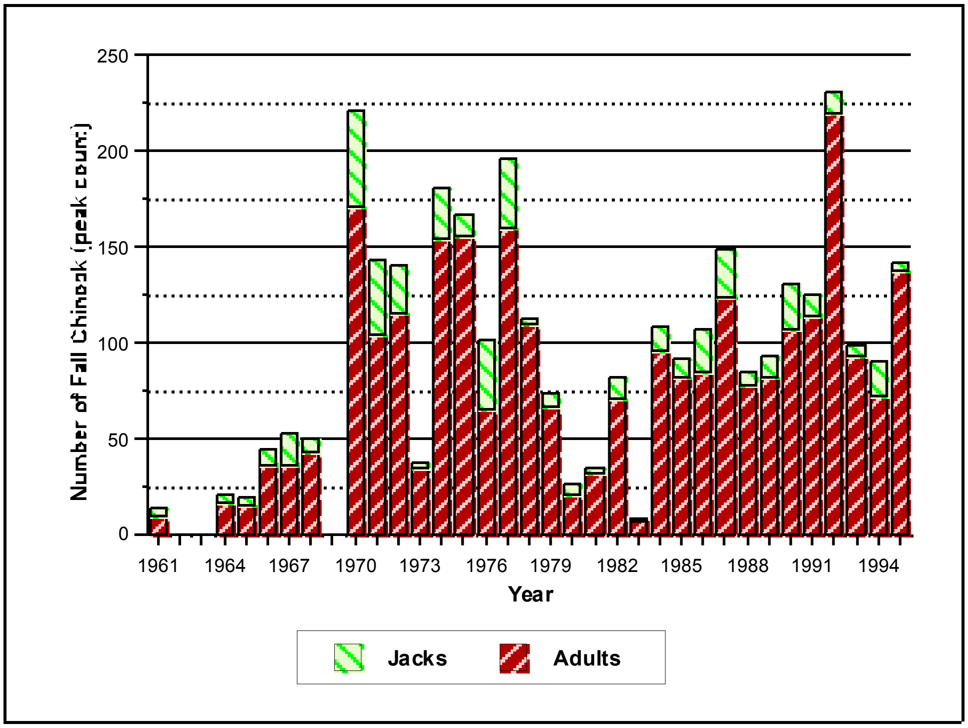

Figure IV.4. Fall Chinook peak counts (East Fork Coquille River lower ODFW standard reach)

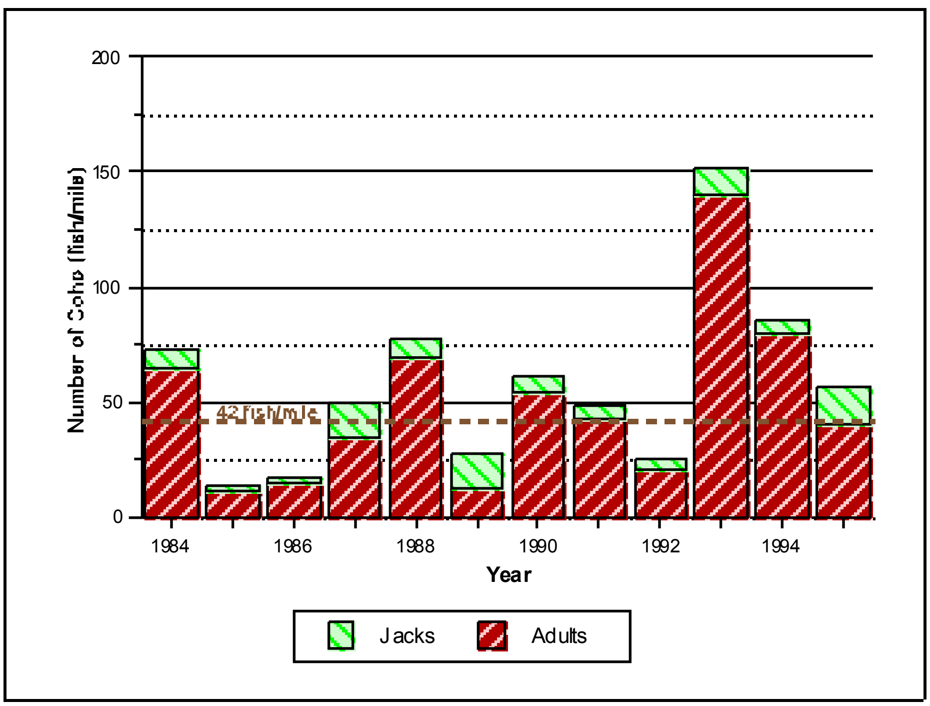

Figure IV.5. Steel Creek Coho (fish/mile). From ODFW standard survey reach.

As with chinook, it is assumed that coho population levels and trends in the analysis area have mimicked those of the Coquille basin. Standard spawning ground surveys of coho conducted throughout the Coquille basin since 1958 show a clear decline in spawning escapement (ODFW 1995a). More recent data indicates that from 1985-1995, the population of adult wild coho salmon within the entire Coquille basin was below the minimum escapement goal of 16,380 (42 fish/mile) for eight of ten years. However, as indicated in Figure IV.5, Steel Creek faired better than the Coquille basin as a whole, meeting the minimum escapement goal five out of ten years. Other spawning ground surveys conducted from 1990-1997 by BLM and ODFW [including random survey reaches] are presented in Figures IV.6 and IV.7 (reports on file in MRA and ODFW). These data indicate that Steel Creek has a markedly higher coho spawning escapement than other streams, and does not accurately represent spawning escapement in the remainder of the watershed, with the exception of Weekly Creek.

Winter Steelhead

The steelhead trout of the analysis area are part of a gene conservation group extending from the Umpqua to the Lower Rogue Rivers. There have been few or no genetic studies conducted on steelhead in this region and as a result, there is an absence of genetic information on steelhead in the Coquille and surrounding basins (ODFW 1995b).

Steelhead enter and spawn in the analysis area from mid-January through the first week in April. The spawning period for steelhead is quite protracted, but peaks have been observed one each in February and in March (depending on rainfall events).

Typically, the only information gathered on spawning winter steelhead has been collected incidentally during coho salmon spawning surveys. As a result, current population size and carrying capacity of adult and juvenile winter steelhead in the Coquille River are unknown (ODFW 1992), but are likely below the spawning population escapement goal of 10,000 fish. Based on angler catch records, winter steelhead populations in the Coquille River were below their 20-year average during seven out of ten years from 1981-1990 (Nickelson *et al.* 1992c), suggesting a downward trend in the winter steelhead population of the Coquille River. The BLM has conducted steelhead spawning surveys, but there is insufficient information to estimate the watershed or basin population and the data suggest no trend in escapement.

Other Fish Species

No data is available from which to assess the population status of other fishes (sculpins, Cyprinids, lamprey) in the analysis area. Anecdotal information suggests that the numbers of spawning resident and sea run cutthroat trout are below historic levels (ODFW 1992). Speckled dace populations are suspected to be above historic levels or at least more widely distributed due to water temperature increases within the watershed.

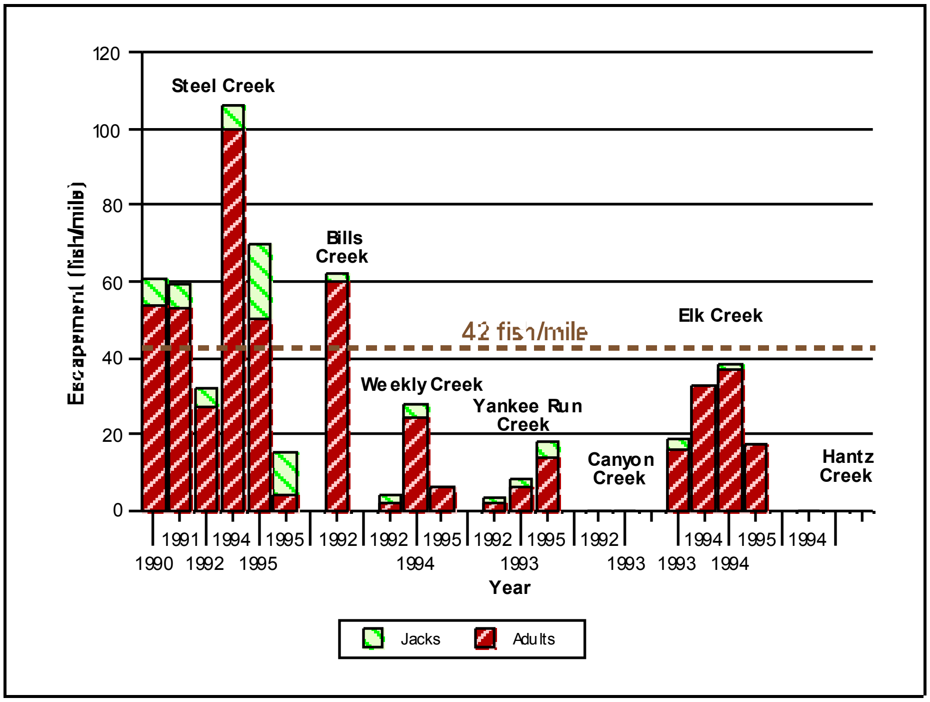

Figure IV.6. Coho spawning ground counts from ODFW random reaches.

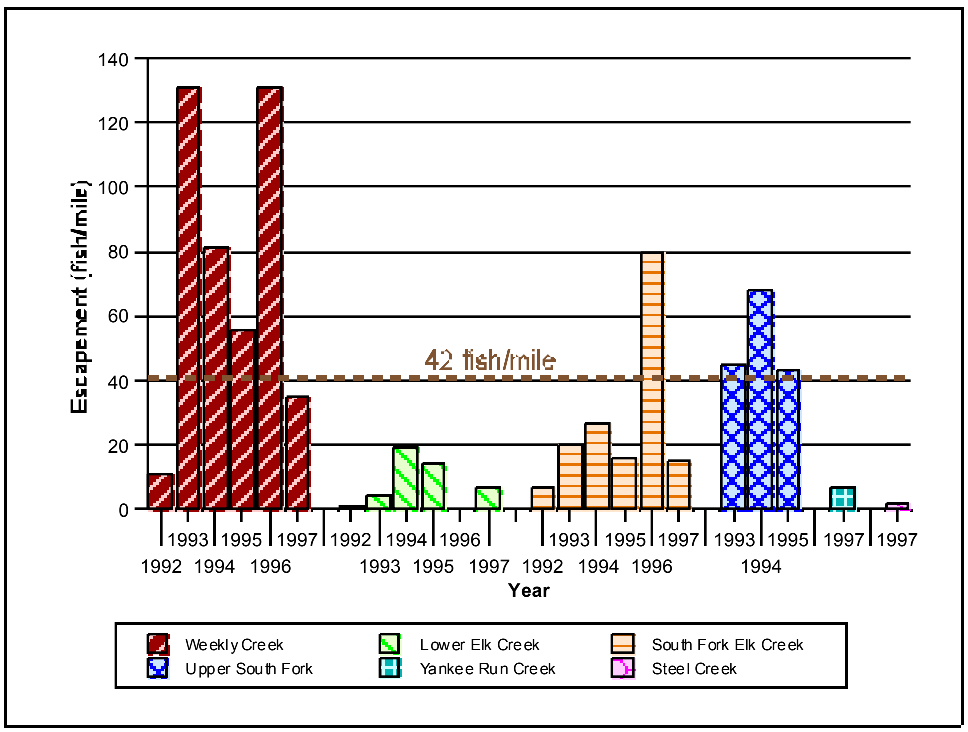

Figure IV.7. Adult Coho spawning ground counts for BLM standard reaches.

ANALYTIC QUESTION IV.3.3

How have management activities and natural processes changed the abundance, distribution and movements of fish species?

Early human impacts to aquatic and riparian habitats included grazing, small-scale agriculture, logging, splash-damming, small-scale road-building, and extensive beaver trapping. Numerous homesteads were established between Gravelford and Brewster Valley before the turn of the century. Log drives occurred from Dora as early as 1884, and four splash dams were operated on the mainstem East Fork Coquille between 1921 and 1949. Elk Creek and Steel Creek also were splash-dammed during this same period. Later in the 20th century, additional residential development, widespread timber harvest and road building, beaver dam removal, and stream-cleaning were common.

Management activities over the last century have impacted the abundance and quality of critical habitat factors, resulting in diminished system capacity to support fish populations. A fish ladder was constructed in Brewster Gorge in 1987, with the intent of extending the distribution of anadromous salmonids. Prior to the ladder's construction, the steep cascade through Brewster Gorge presented a barrier to upstream fish migration (with the exception of Pacific lamprey and possibly steelhead under certain flow conditions). Since the ladder's construction, steelhead (winter) and Pacific lamprey have been regularly observed spawning upstream of the gorge, in the mainstem river, Camas Creek and Brummit Creek (BLM spawning survey data, reports on file at the Coos Bay District office). Despite numerous releases of hatchery-reared coho juveniles into Camas Creek and Brummit Creek, adult coho have not been observed spawning upstream of the ladder. Coho and chinook salmon apparently are unable to negotiate the cascades immediately upstream of the ladder.

SYNTHESIS AND INTERPRETATION

ANALYTIC QUESTION IV.3.4

What are the ecosystem processes and elements that relate to and influence fish species?

For a given number of spawners and seeding level, habitat conditions that set carrying capacity for rearing include stream productivity, abundance of certain habitat types (such as pools), and the quality of those habitats (i.e., complexity, water velocity and quality, depth, turbidity). The quality of spawning habitat is affected by substrate composition, cover, water quality and quantity. Successful incubation depends extra- and intra-gravel chemical, physical and hydraulic variables, dissolved oxygen, water temperature, amount of fine sediment, etc. Access to suitable habitat for spawning and rearing may also be important in setting population levels.

Stream Productivity

Stream productivity and fish production and survival are positively correlated (McFadden and Cooper 1962, Konopacky 1984, Meehan and Murphy 1991) and abundance of food (macroinvertebrates) may override even cover in determining carrying capacity of juvenile salmonids in summer months (Christensen 1996). Management activities over the last century have reduced the input and retention of nutrients in streams. Roads can affect streams directly by accelerating erosion and sediment loadings, by altering channel morphology and by changing the runoff characteristics of watersheds (Meehan 1991). Large amounts of fine sediment reduce or eliminate much of the suitable substrate for producing macroinvertebrates, thereby limiting the food available to juvenile fish (Cordone and Kelly 1961, as cited in Meehan 1991).

Intensive road-building in the analysis area has likely increased sediment supply, modified runoff, and altered water and substrate quality, ultimately reducing macroinvertebrate populations. In reaches where macroinvertebrate communities are supported by inputs of organic material from riparian zones, removal of large wood from the channel has diminished the stream's capacity to retain the nutrients. Additionally, alteration of riparian vegetation during timber harvest and road-building has removed a major food source for macroinvertebrates. Typically, removal of streamside vegetation increases incoming solar radiation, causing concomitant increases in algae-dependent macroinvertebrate populations. However, fish production in the analysis area is not likely to respond positively because higher water temperatures are likely to outweigh benefits from the increased food supply. Finally, diminished salmon returns in the watershed subsequently have diminished the nutrient inputs associated with large numbers of salmon carcasses following the spawning season.

Habitat Abundance & Quality

Pool abundance and quality is a major factor affecting abundance and survival of juvenile salmonids (Nickelson *et al.* 1992a). Despite the fact that pool habitat is abundant in many streams, nearly all pools are scour pools. Backwater, alcove, and beaver dam pools are very rare or absent in the watershed. Scour pools, unlike backwater, alcove and beaver dam pools, are erosional at high flows and therefore do not provide optimal winter rearing habitat for most salmonids. In particular, juvenile coho salmon avoid high velocity [scour] pools at high flows and instead utilize backwater, alcove and beaver dam pools (Nickelson *et al.* 1992a and 1992b).

The removal of beaver and beaver dams throughout the watershed has reduced the abundance of an important habitat type for salmonids. Typically, proliferation of beaver and beaver dams may be closely linked to fish production and survival (Olson and Hubert 1994) and high densities of coho salmon often are found in beaver ponds. In fact, production of coho salmon smolts in many Oregon coastal streams is suspected to be limited by the availability of habitats created by beaver activity (Nickelson *et al.* 1992b). In addition to providing complex pool habitat, beaver dams also trap sediments, help maintain summer base flows, reduce stream temperatures, improve riparian vegetation development by changing the water table, and reduce water velocities and scour (Olson and Hubert 1994). Thus, the reduction of beaver and beaver dams likely is a major cause in declines of salmon populations (particularly coho) from historic levels.

Although most stream data collected and subsequent management focuses on larger streams (4th order or greater), most of the stream miles in the watershed are made up of small streams (see Appendix A - Map A.7). Because small streams are so numerous in the watershed and because they dissect the uplands, they are most likely to be affected by management.

Small streams partly are responsible for habitat quality and nutrient availability in larger tributaries downstream. Fishes such as coho salmon and cutthroat trout often are found spawning and rearing in these small perennial systems. Small streams also provide habitat for a variety of amphibian and invertebrate species. They typically contain considerable micro-habitat diversity, producing rich biotic communities supported by allochthonous inputs from the adjacent forests. These small upland systems often contain species not found in mainstems or lower reaches (Tew 1971). For example, in the adjacent Sandy Creek drainage, limited sampling in small streams produced greater caddisfly diversity than was present in mainstem Sandy Cr., including seven species not found in the mainstem itself (USDI 1997b).

Persistence of these small-stream communities depends on stability of small stream channels (maintained by riparian vegetation and down wood), flow regime, and shade and detritus contributed by riparian vegetation.

There have been no systematic surveys of amphibian or aquatic invertebrate habitat in the East Fork Coquille Watershed. Typically, habitat conditions important for aquatic amphibians and invertebrates (which spend some or all of their life in the water) are similar to that of fishes: water temperature and chemical composition, water velocity, stream productivity, amount of solar radiation, and physical variables such as substrate composition, habitat complexity, availability of cover, etc. (Hynes 1970, Nussbaum *et al.* 1983, deMaynadier and Hunter 1995). Invertebrate diversity usually is closely associated with substrate diversity and complexity of flow patterns (Christensen 1996). It is therefore assumed that management activities affecting instream habitat, flow patterns or riparian vegetation affect small stream communities in much the same way as the larger systems.

Beaver complexes have been noted in Weekly Creek tributary (T29S, R11W, Section 5 - NW¼), South Fork Elk Creek (T28S, R10W, Section 19 - SW¼), and Steel Creek (T28S, R11W, Section 1 - NW¼).

ANALYTIC QUESTION IV.3.5

What natural and management-related processes have the potential to reduce or limit the viability of these organisms?

The presence of man-made barriers limits the ability of fishes and other species to access historic habitat. The capacity of aquatic and terrestrial species to access their habitats and refugia is an important factor in ensuring their survival. Movement and dispersal may also be necessary to create and maintain genetic diversity. Formerly continuous populations that become reduced in size and isolated by barriers are more susceptible to genetic, demographic, and environmental changes (Shaffer 1981, Soule 1987).

Only five culverts in the analysis area are barriers to salmonids; however, the vast majority are barriers to non-jumping aquatic organisms, including sculpin, crayfish, molluscs, and other invertebrates. Some adult amphibians are capable of overland travel and may be able to by-pass problem culverts; however, research indicates that roads also may significantly inhibit the movement of some salamander species (deMaynadier and Hunter 1995). For a Southern Torrent salamander, which is rarely found farther than one meter from a stream (Blaustein *et al.* 1995, Bury 1996, Applegarth 1996), roads likely present a nearly impassable barrier. Because many riparian areas are bisected by roads, maintenance of intact riparian areas as dispersal routes may be important for aquatic species, and may provide the only dispersal route for some terrestrial species.

Barriers to the passage of certain aquatic organisms may have serious impacts on ecosystem process in small streams above barriers. Amphibians, crayfish, and invertebrates make up a large portion of the biomass produced in aquatic systems, contribute to the maintenance of food webs by processing vegetation and leaf litter, and increase availability of nutrients to other organisms (Hynes 1970, Christensen 1996, Taylor *et al.* 1996).

A variety of natural factors (described below) limit population levels of resident and anadromous salmonids in the watershed. Management activities affect salmonid production and survival when they alter the frequency or magnitude of these natural factors.
During all freshwater life stages, the major factors determining salmonid production and survival are water quality, habitat quality and availability, and food abundance. Incubation success is particularly affected by flow extremes, temperature, silt levels, and predation. Immediately after hatching, a large percentage of mortality is due to physiological stress during the conversion from yolk feeding to exogenous food sources and the establishment of territories. For the remainder of freshwater rearing, major factors regulating abundance change seasonally. In summer months, food availability and temperature-caused physiological stress are major limiting factors. During the winter, when fish switch from active feeding and growth to conserving energy, availability of suitable winter habitat limits abundance.

The effects of specific management practices on watershed and channel processes have been described in detail elsewhere in this document (see AQ III.8.4 – III.8.6; AQ IV.3.3 and IV.3.4). In general, these practices directly affect fish production and survival when they alter the levels or timing of peak and base flows, accelerate sediment delivery to streams, disrupt channel equilibrium, reduce or limit habitat complexity, diminish the food supply, or increase stream temperatures.

In the freshwater environment, the effects of management activities on salmonids may not be equal across all species. Resident trout and coho salmon may be particularly susceptible to limiting factors in the freshwater environment because they spend a greater portion of their life-cycle in freshwater than do chinook. Based on the relatively low survival rates from coho fry to smolt when compared to chinook (Sandercock 1991), it is apparent that the freshwater environment plays a major role in the fluctuation of coho abundance. Management activities over the last century have differentially affected habitat required by coho salmon for life-stages where highest mortality rates are typically observed. For example, survival during the critical period immediately after emergence is dependent on the availability of low velocity areas and the ability of coho fry to establish territories within them (Sandercock 1991). Management activities in the analysis area have eliminated channel-margin habitat and complex pools which provide refuge for fry. Additionally, activities resulting in channel incisement, the disconnection of streams from floodplains, and removal of beaver dams have eliminated off-channel and floodplain habitats required by coho for winter rearing. Elimination of winter rearing habitat is proposed as the major factor limiting coho production in coastal streams (Nickelson *et al.* 1992a).

Interspecific competition in freshwater habitats may also limit the abundance of some salmonid species. For example, although cutthroat and steelhead trout prefer pools with overhead cover, in the presence of coho salmon, they may be excluded from these habitats (Hartman 1965, Bugert 1985, Glova 1986). The effects of interspecific competition for habitat may be exacerbated by management activities which limit habitat abundance and complexity, or that introduce coho into sections of streams normally accessible only to resident fish. Typically, complex pools support higher densities and diversity of fish species. Management activities in the analysis area such as stream cleaning or riparian harvest that reduced or removed instream structure have limited the capacity of watershed streams to support diverse communities of salmonids.

Other Fish Species

Information has not been collected on non-salmonid species in the watershed and it is therefore difficult to identify population trends and the major factors affecting abundance and survival. It is likely that non-anadromous species such as brook lamprey, sculpin and the Cyprinids in the analysis area have been particularly affected by management activities since these species occupy freshwater throughout most or all of their lifetimes.

Based on knowledge of habitat requirements for these species, it routinely assumed that management activities affecting abundance and diversity of habitat for salmonids have also affected habitat conditions for other species. For example, ammoecetes of Pacific Lamprey spend five years in freshwater, rearing in depositional areas in pools and along channel margins. It is probable, therefore, that management activities in the analysis area which have increased scour and downcutting have reduced the abundance of low-velocity depositional areas required by lamprey.

Beaver

In the absence of trapping pressure, beaver abundance is regulated by the density of available territories, and the density of territories is limited by available food (Payne 1984). It is not known whether beaver population levels in the analysis area are limited by trapping pressure or habitat and food conditions. It is possible that the lack of “velocity checks” (provided by down wood in the stream channel) throughout the watershed precludes dam-building.

ANALYTIC QUESTION IV.3.6

What are the population trends of fish species?

Insufficient data exist to assess fish population trends and to quantify the impact of East Fork Coquille salmon stocks on the health of the Coquille Basin. It is assumed that population dynamics in the watershed generally mimic those at the larger scale (Coquille Basin). A comparison of current and historical conditions indicate that, at the 5^{th} field scale, coho salmon and steelhead stocks have declined in recent years, while chinook salmon appear to be depressed but fairly stable. Protection of aquatic and riparian habitats on public lands and restoration initiatives on both public and private lands will likely assist in the recovery of anadromous and resident fish stocks, provided ocean conditions and fish harvest management are concurrently favorable.

Implementation of the Aquatic Conservation Strategy of the Northwest Forest Plan should improve habitat conditions for most aquatic and riparian-associated species on federal land. On State and private lands, NMFS draft proposal concerning Oregon forest practices (NMFS 1998) indicates that current Oregon Forest Practices Rules are weak with respect to the small size of riparian areas protected, particularly for small streams (NMFS 1998:37). In addition, they suggest the current ODF Rules are “uncertain to unlikely” to meet restoration objectives (NMFS 1998:36).

ANALYTIC QUESTION IV.3.7

What are the management objectives for aquatic species?

Management in the watershed should focus on providing habitat conditions conducive to self-sustaining populations of native anadromous and resident species.

For chinook salmon, which spend only a short time in fresh water, it is extremely difficult to conduct meaningful assessments of population sizes and trends at the watershed scale based on numbers of returning adults (spawning) because inter-annual and between-population variation are typically great (Healey and Heard 1984). Management objectives should therefore focus on establishing and measuring conditions known to maximize chinook production and survival (abundant, clean gravel/cobble beds for spawning and incubation, presence of marginal areas and complex pools for rearing) and preventing or minimizing conditions known to cause widespread mortality of eggs, alevin, and fry (instability of gravel beds, lack of velocity checks, sedimentation).

For coho salmon and steelhead trout, which may spend several years in the analysis area, freshwater rearing conditions may play a dominant role in regulating abundance and survival. Management should focus on establishing and measuring freshwater rearing conditions known to maximize production and survival of these fishes (abundant, clean gravel beds for spawning and incubation, presence of low-velocity, complex in-channel and off-channel pools, good water quality and sufficient food supply) and preventing or minimizing conditions known to reduce survival and abundance (instability of gravel beds, sedimentation, low abundance of suitable rearing pools, high stream temperatures, etc.). Attainment of this objective means reaching minimum summer seeding (rearing) levels of approximately 1 coho parr/m^2 /pool (Nickelson *et al.* 1992c).

Cutthroat trout may spend their entire life-history within the analysis area. Specific habitat objectives for chinook and coho salmon and steelhead trout should benefit cutthroat trout as well. In particular, activities which increase habitat complexity will subsequently reduce interspecific competition between cutthroat trout and the dominant competitor, coho salmon. In addition, management should focus on maintaining connectivity to historic small-stream habitat and refugia for native trout (through the removal of barrier culverts and protection of small streams). Finally, introduction or release of coho salmon above historic, natural barriers in the watershed should be discouraged to protect resident trout populations (OAR 635-07-523).

Little is known about the habitat requirements of other fish species in the watershed, such as the sculpin, Cyprinids, and lamprey. In general, management actions which maintain or improve water quality and increase habitat complexity and food abundance should benefit these species as well.

ANALYTIC QUESTION IV.3.8

What management opportunities exist to maintain and/or restore desired populations of aquatic species?

The riparian and aquatic habitat restoration recommendations (found in Section VIII) are intended to benefit aquatic species. Additional measures that would address known data gaps include:

- Coordinate with ODFW in the development of winter steelhead spawning escapement goals by providing spawning survey data, maps, and analysis.
- Coordinate with ODFW in developing a population database for non-salmonid fish species (Pacific lamprey should receive a high priority).
- Continue to cooperate with ODFW, ODF, the Coquille Watershed Association, and private landowners to field verify and map the distribution of anadromous and resident fish in accordance with ODFW protocol.
- Continue to assist ODFW with field sampling for genetic analysis of resident fish populations.